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# Total factor productivity and the environmental Kuznets curve ☆

Ariaster B. Chimeli[a,*], John B. Braden[b]

[a] *Department of Economics, Ohio University, 319 Bentley Hall Annex, Athens, OH 45701, USA*
[b] *University of Illinois at Urbana-Champaign, USA*

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**Abstract**

Empirical studies support the environmental Kuznets curve hypothesis (EKC) for some pollutants—as income increases pollution increases, reaches a peak and eventually decreases. While relying mostly on cross-sectional data, the interpretations assert that the EKC is a by-product of economic growth over time. In doing so, and in neglecting the role of important country-specific characteristics, these studies overlook potential econometric problems and introduce policy misconceptions. Differences in total factor productivity (TFPs) account for much of the variation in income across countries, with important implications for environmental quality. We develop a theoretical model where different TFPs produce a cross-sectional EKC, even if the dynamic path of environmental quality to its steady-state in individual countries suggest otherwise. The cross-sectional EKC depends on diminishing returns to scale in environmental protection, on the curvatures of the utility function with respect to consumption and of the

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* Corresponding author. Fax: +740-593-0181.
*E-mail address:* chimeli@ohio.edu (A.B. Chimeli).

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environmental protection function, and the elasticities of steady-state consumption and environmental expenditures with respect to variation in TFPs.
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## 1. Introduction

This paper investigates how differences in total factor productivity (TFP) affect environmental quality in different countries. We develop a theoretical model where different TFPs produce a U-shaped relationship between environmental quality and income in a cross-section of countries, even if the path of environmental quality to its steady-state value is monotonic in individual countries. This relationship is implied by the environmental Kuznets curve (EKC), an inverted U-shaped relationship between pollution and income.[1] We conduct the analysis by performing comparative statics in the Pareto optimal steady-state of a dynamic economy where different TFPs are considered.

The EKC is often interpreted as a by-product of economic growth, implying that the decline and subsequent recovery of environmental quality is a matter of time reflecting the natural path of economic development. For example, Grossman and Krueger [12, p.372] state that "(...) air and water quality appear to benefit from economic growth once some critical level of income has been reached." In a similar empirical paper, Selden and Song [22, p.147] write that "(...) it is reasonable to expect that economies would pass through 'stages of development', in which at least some aspects of environmental quality first deteriorate and then improve." However, since time-series data on pollution and environmental quality are generally short and variable in quality, evidence on the EKC relies heavily on cross-sectional observations. The use of cross-sectional data raises the question of whether country-specific characteristics matter when explaining the EKC. If this is the case, as this paper suggests, the time-series interpretation bears an extra burden of proof.

In addition to neglecting the importance of country-specific characteristics in the explanation of the EKC, a potential estimation problem arises as most empirical studies on development and the environment use panel data. With panel data analysis, the effect of country-specific characteristics can be explored by estimating fixed or random effects models. However, when country-specific characteristics are correlated with income, the estimates of the relationship between growth and the environment are subject to bias and inconsistency [13]. This paper provides theoretical support for these qualifications by considering the environmental implications of different TFPs in different countries.

Prescott [20] argues that neoclassical growth models fail to account for the great disparity in incomes across countries unless we are willing to consider TFP differences as a key determinant. According to Parente and Prescott [18,19], although knowledge and technologies are fairly easily transferable, especially given the widespread presence of multinational firms around the world,

[1]See for example, Shafik and Bandyopadhyay [24], Grossman and Krueger [12], and Selden and Song [22].

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